MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

EEE1026 – ELECTRONICS II

(All Sections / Groups)

02 MARCH 2017
02:30 p.m. - 04:30 p.m.
(2 Hours)

INSTRUCTION TO STUDENTS

1. This Question paper consists of **8** pages including cover page and **List of Equations** with **4** Questions only.

2. Attempt **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the answer Booklet provided.

QUESTION 1

(a) The Junction Field-Effect Transistor (JFET) is a fundamental electronic device that can be used as an electronic switch, which can also be constructed into amplifier.

(i) Describe TWO methods to control the current flow in the operation of the JFET. [4 marks]

(ii) Describe FOUR advantages of the JFET compared to Bipolar Junction Transistors (BJTs). [8 marks]

(b) Refer to the circuit shown in Figure Q1(b), where the circuit output voltage has a 1V loss.

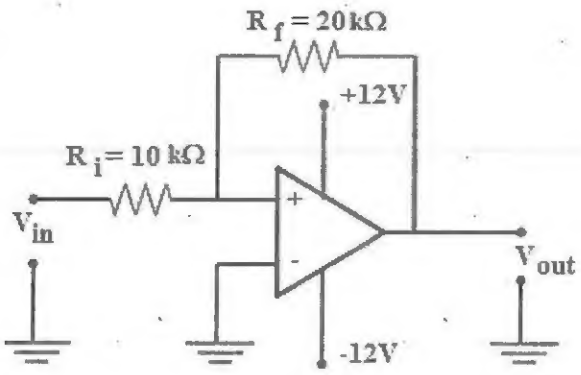

Figure Q1(b)

(i) Compute the voltage value of the upper trigger point (UTP). [4 marks]

(ii) Compute the voltage value of the lower trigger point (LTP). [4 marks]

(iii) If the input voltage, V_{in} is a sinusoidal signal with peak-to-peak voltage, V_{pp} = 30V. Sketch the output voltage, V_{out} waveform with respect to its input voltage, V_{in} waveform. [5 marks]

Continued ...

QUESTION 2

(a) The junction Field Effect Transistor (JFET) Small signal model is shown in Figure Q2(a), with $R_G = 20k\Omega$, $r_d = 30k\Omega$, $R_D = 3k\Omega$, $R_L = 1k\Omega$, $C_{gs} = 2.5pF$, $C_{gd} = 2pF$, $C_{ds} = 1pF$, $A_V = -8$ and $g_m = 2\text{mA/V}$.

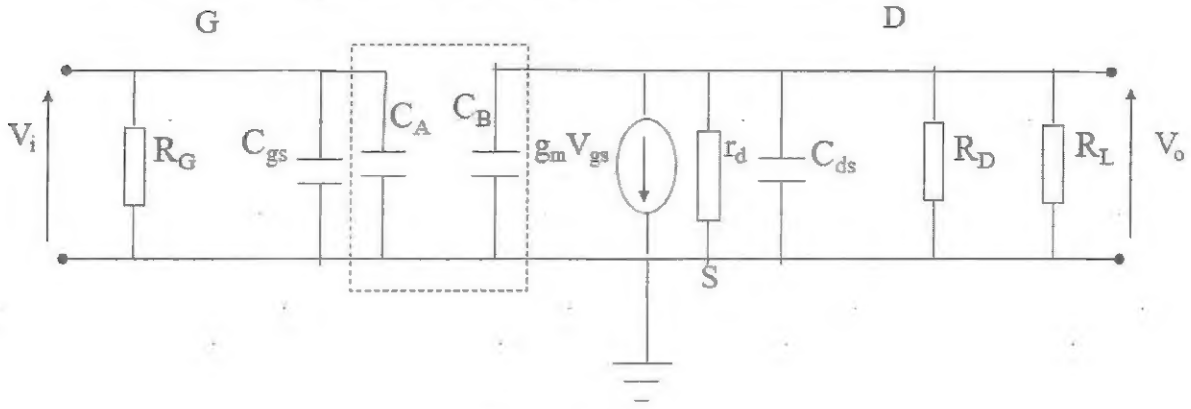

Figure Q2(a)

(i) Compute the values of C_A and C_B. [4 marks]

(ii) Compute the values of the total input resistance R_{Ti}, total input capacitance C_{ti}, total output resistance R_{To} and total output capacitance C_{to}. [5 marks]

(iii) Compute the values of the upper cutoff frequencies at the input and output circuits, f_{Hi} and f_{Ho}. [3 marks]

(b) The input of the amplifier circuit is fed with an 2mV 10kHz square wave. The resultant output waveform is shown in Figure Q2 (b). Find the following:

(i) Rise time (t_r) [1 mark]

(ii) The bandwidth of the amplifier [2 marks]

(iii) Tilt (P)% [2 marks]

(iv) The low cut-off frequency [2 marks]

Continued ...

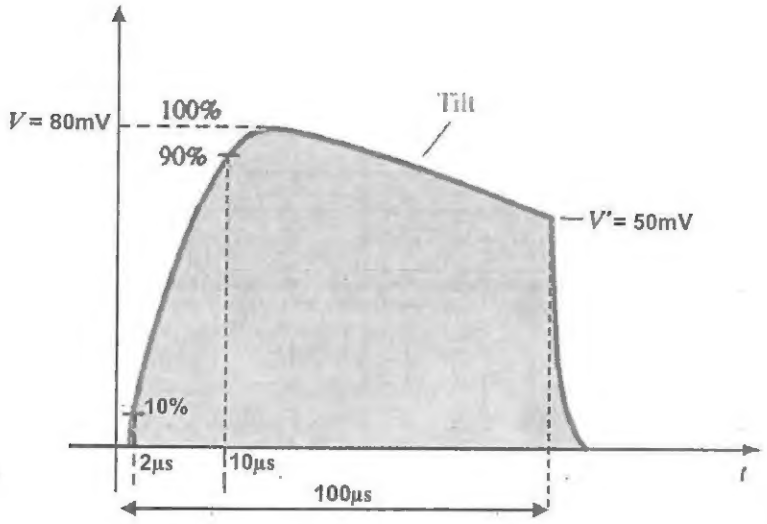

Figure Q2 (b)

(c) A Common-Emitter BJT amplifier circuit is shown in Figure Q2 (c). Given values: R_1=100kΩ, R_2=33kΩ, R_C= 2.2kΩ, R_E=1kΩ, r_e =10Ω R_S=10kΩ, V_{CC}=15V, βac =120 and R_{th} =7.127kΩ, determine the cut-off frequency of the bypass RC circuit.

[6 marks]

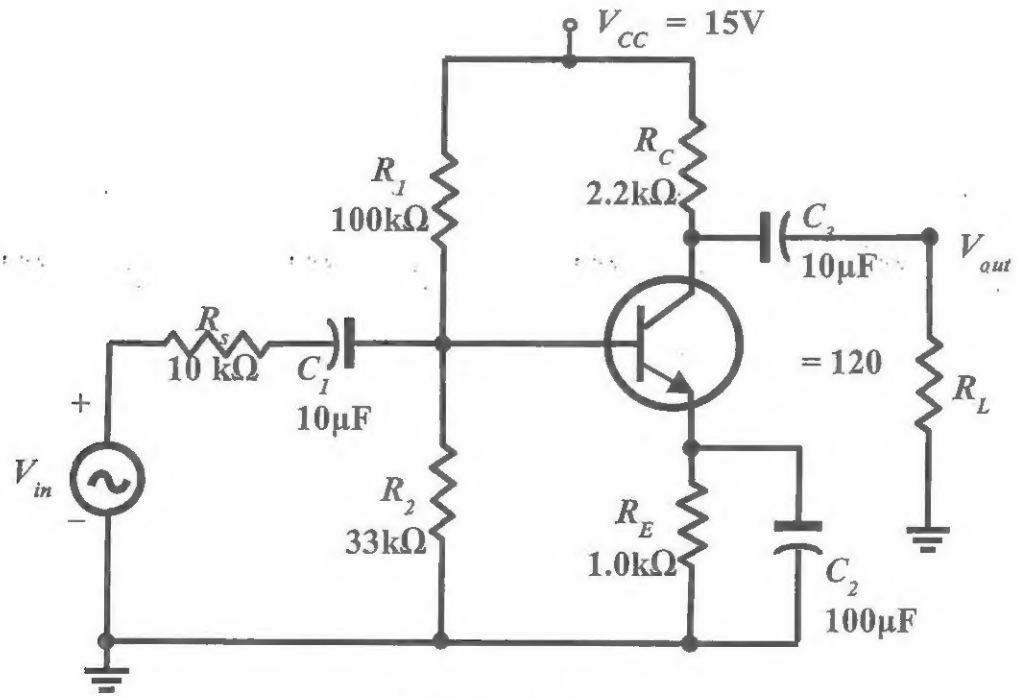

Figure Q2 (c)

Continued ...

QUESTION 3

(a) An RC-coupled class-A power amplifier is shown in Figure Q3. The BJT amplifier has an amplification factor, $\beta = 150$. Calculate the DC load line values of $V_{CE(cutoff)}$ and $I_{C(sat)}$. [8 marks]

(b) Calculate the following, based on Figure Q3:

(i) The base voltage V_B. [3 marks]

(ii) The voltage across emitter resistance V_E [3 marks]

(iii) The collector current at the Q-point I_{CQ} [2 marks]

(iv) The collector-emitter voltage at Q-point, V_{CEQ}. [3 marks]

(v) The effective AC resistance of the load r_o. [2 marks]

(vi) $v_{ce(off)}$ and $i_{c(sat)}$. [4 marks]

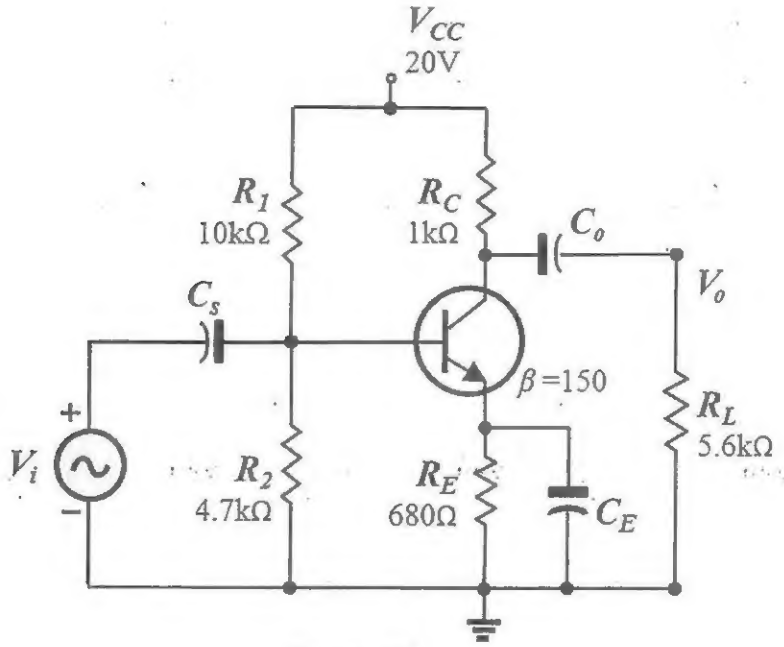

Figure Q3

QUESTION 4

For an n-channel Junction Field-Effect Transistor (JFET), the gate-source cut-off voltage, $V_{GS(OFF)}$, is -4 V and the drain saturation current, I_{DSS} is 50 mA. The drain current I_D, is 12 mA. Determine the gate-to-source voltage, V_{GS}, of the JFET. [4 marks]

Continued ...

(a) For an n-channel JFET amplifier circuit given in Figure Q4(b), the $V_{GS(OFF)} = -5$ V, the $I_{DSS} = 4$ mA, and the $V_{GS} = 0$ V. The drain supply voltage, V_{DD}, = 20 V, is larger than the pinch-off voltage, V_P ($|V_{GS(OFF)}| = |V_P|$), so that the transistor operates in the saturation region. Determine the following:

(i) the drain current, I_D, [2 marks]

(ii) the drain-source voltage, V_{DS}, [3 marks]

(iii) the drain voltage, V_D , and [2 marks]

(iv) the source voltage, V_S. [2 marks]

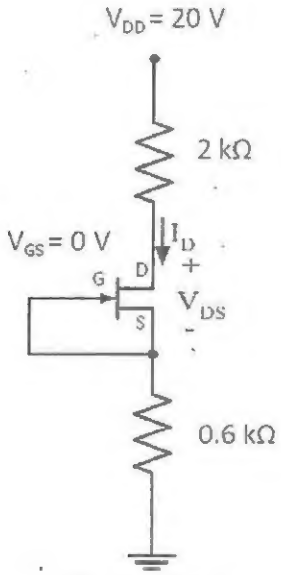

Figure Q4(b)

(c) Refer to the circuit of the astable multivibrator shown in Figure Q4(c), with the $V_{CC} = 12$V, $R_A = 5$kΩ, $R_B = 2$kΩ and $C_1 = 0.02$μF.

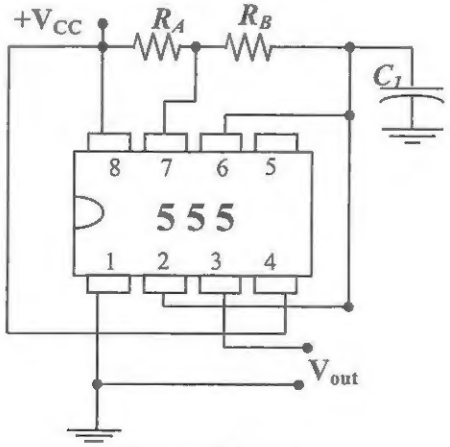

Figure Q4 (c)

(i) Compute the value of pulse width, T1. [2 marks]

(ii) Compute the value of space width, T2. [2 marks]

(iii) Compute the value of free running frequency, f_o. [3 marks]

(iv) Compute the value of the duty cycle, D. [3 marks]

(v) Design the multivibrator by computing the new value of resistor, R_A, if the ratio of space width/pulse width, T2/T1 = 0.9. [2 marks]

End of Questions

Appendix

List of Equations

$$I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_{GS(OFF)}}\right)^2$$

$$\text{UTP} = \frac{-Ri}{Rf}V_{out-} \qquad \text{LTP} = \frac{-Ri}{Rf}V_{out+}$$

$$C_A = Cgd\ (1\text{-}Av),\ C_B = Cgd\ (1 - 1/Av)$$

$$f_{Hi} = \frac{1}{2\pi R_{Ti}C_{ti}} \qquad f_{Ho} = \frac{1}{2\pi R_{To}C_{to}}$$

$$\text{Tilt\%(P)} = \frac{V - V'}{V}, \qquad f_L = \frac{P}{\pi}f_s$$

$$f_{c(bypass)} = \frac{1}{2\pi(R_{iin(emitter)} \parallel R_E)C_2}$$

$$V_{CC} = I_C R_C + V_{CE} + I_E R_E$$

$$V_B = \frac{R_2}{R_1 + R_2}V_{CC}$$

$$PW = T_1 = 0.693\ (R_A + R_B)\ C_1\ ,\ SW = T_2 = 0.693\ R_B C_1$$

$$f_o = \frac{1.44}{(R_A + 2R_B)C_1}$$

End of Paper